ENGINEERING EVALUATION AND COST ANALYSIS EQUIVALENT (EE/CA EQUIVALENT)

FOR THE EAST HELENA SMELTER SITE RESIDENTIAL SOILS REMOVAL ACTION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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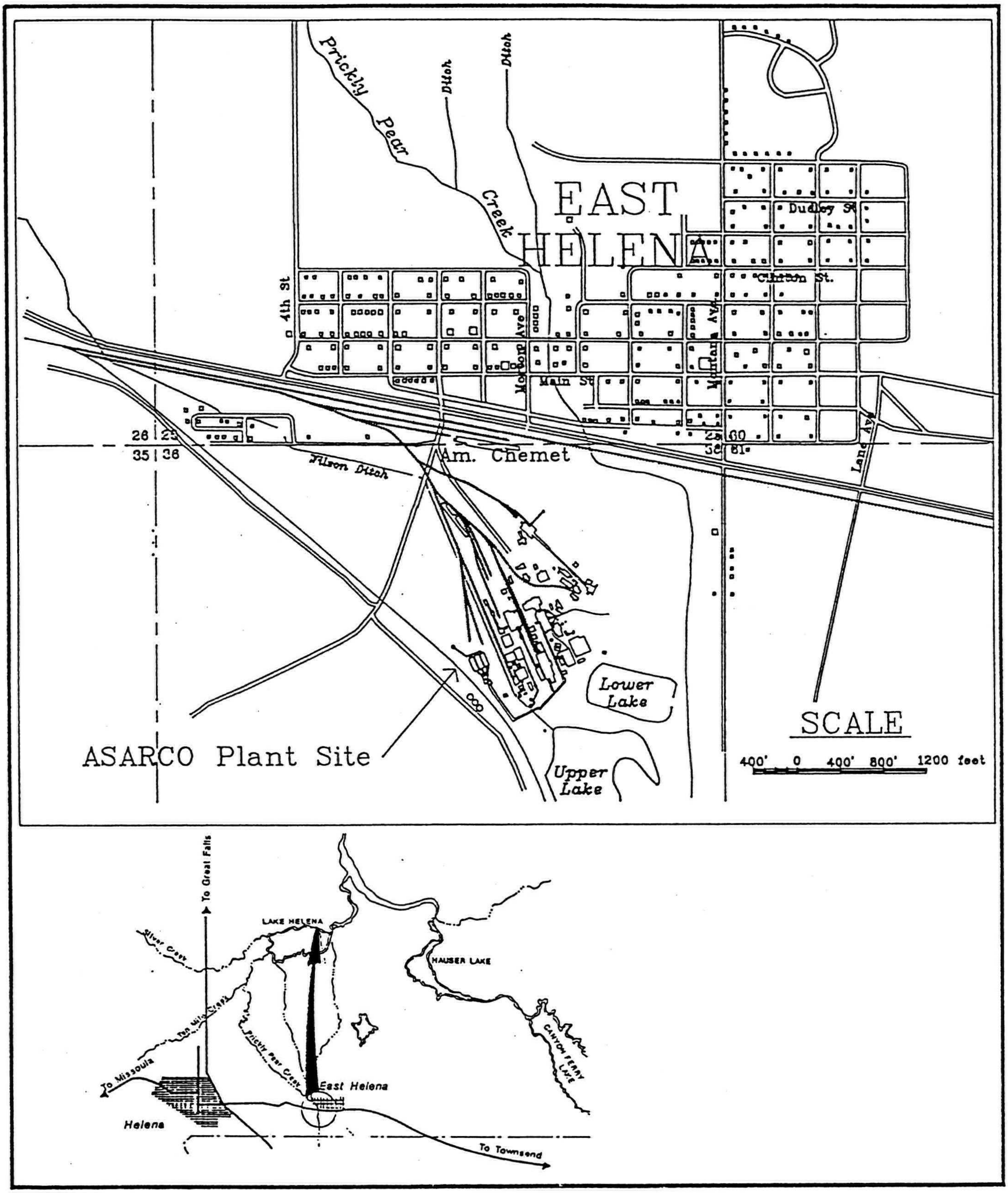
EE/CA EQUIVALENT

1.0 INTRODUCTION

An Engineering Evaluation/Cost Analysis (EE/CA) is a comparative analysis of removal action options for a Superfund Site. The EE/CA process is used to develop, evaluate, and select a non-time-critical removal action. A non-time-critical removal action is a removal action in which a release or threat of release does not require onsite activity within six months of the time the release or threat of release is identified.

This document is an EE/CA equivalent for the residential soils at the East Helena Superfund Site (the Site) located in Lewis and Clark County, Montana (Figure 1-1). The purpose of this EE/CA equivalent is to evaluate residential soils management alternatives at the Site. This EE/CA equivalent provides a site characterization in Section 2.0, a discussion of removal action objectives in Section 3.0, and discussions of removal options and management alternatives in Section 4.0. The Removal Action Alternatives are screened using the criteria of implementability, effectiveness, and cost. The alternatives are compared and a preferred alternative is presented. These discussions are presented in Sections 5.0, 6.0 and 7.0.

The goals of this EE/CA equivalent are to (1) satisfy environmental review and administrative record requirements, (2) provide a framework to evaluate alternative management options for highly contaminated residential soils in East Helena, and (3) select the alternative best suited for successful implementation at the East Helena Site.



NORTH

Figure 1–1 Location Map

2.0 SITE CHARACTERIZATION

This section provides a Site description and history, a brief summary of previous site investigations, and the results of those investigations.

2.1 SITE DESCRIPTION

The ASARCO smelter is a primary custom lead smelter located in Section 36, and Township 10 North, Range 3 West, at 46° 34' 51" North latitude and 111° 55' 13" West longitude, in the town of East Helena, in Lewis and Clark County, Montana. The plant, which has operated for more than 100 years, recovers base metals from ore concentrates using pyrometallurgical processes. Though the plant is a primary lead smelter, it has also recovered zinc in the recent past. Major features of the facility include: the slag pile, ore storage areas, water storage ponds, the sinter plant, blast furnace, dross plant, acid plant and the former zinc plant (1927-1982). The American Chemet Corporation, a zinc packaging operation is located adjacent to the ASARCO plant.

The town of East Helena and the ASARCO smelter are approximately four miles east of Helena, Montana, in a gently sloping portion of the Helena valley, at an elevation of about 3900 feet above mean sea level.

<u>Water Resources</u> The Community of East Helena and the surrounding area are underlain by unconsolidated alluvium deposited by ancestral Prickly Pear Creek. The alluvial deposits have variable permeabilities and consist of layers and mixtures of cobbles, gravel, sand, silt and clay.

Prickly Pear Creek itself flows north through the western part of the community of East Helena. Its headwaters are located in the Elkhorn mountains south of East Helena. Prickly Pear Creek drains into Lake Helena, approximately seven miles north of the community.

Groundwater in the East Helena area and the surrounding Helena Valley generally moves north and east toward Lake Helena, which is a discharge point for the valley groundwater system. Groundwater recharge in the Helena Valley comes from precipitation on the valley floor and surrounding mountains and from streams and irrigation canals that cross the valley floor. These streams and canals generally lose significant quantities of surface water into the underlying groundwater system.

Soils Soils in East Helena and the surrounding valley developed on valley fill derived from surrounding mountain ranges, and on lake sediments of Tertiary age. The silt and clay soils are moderately calcareous and have little organic matter. Soil profiles are only poorly to moderately developed.

Climate The climate of the Helena Valley, including the East Helena community and surrounding areas, may be described as modified continental. Seasons typically consist of cold winters, wet springs, and warm summers with moderate thunderstorm activity. Much of the moisture in the area comes in the form of late spring and early summer rain and there are significant winter snow accumulations at higher elevations. Average monthly maximum and minimum temperatures measured during 1951 to 1980 were 67.9 degrees Fahrenheit in July and 18.1 degrees Fahrenheit in January.

Total precipitation varies widely throughout the East Helena area, from a semi-arid total of less than 10 inches in the northern and eastern portions of the Helena Valley, to a sub-humid 30 inches or more along the Continental Divide to the West. The mean annual precipitation for the community is approximately 11.5 inches as recorded at Helena during 1951 to 1980. The greatest amount of precipitation normally occurs in May and June, with precipitation fairly evenly distributed throughout the remainder of the year. Precipitation occurs primarily as snow from November through March and primarily as rain the remainder of the year.

Mean annual evaporation for shallow lakes and reservoirs, estimated by the U. S. Soil Conservation Service in 1974 for the Helena area, is approximately 36 to 38 inches. In the East Helena area, wind direction is from the south the majority of the time. Westerly winds are the next most common wind direction. Highest wind speeds also occur from the west.

2.2 SITE BACKGROUND

The American Smelting and Refining Company (now called ASARCO) purchased the smelter from the Helena and Livingston Lead Smelting company in 1899 and ASARCO has since owned and operated the East Helena smelter. In 1972, ASARCO purchased from the Anaconda Company, Inc., a zinc plant located adjacent to the East Helena smelter Site which recovered zinc by a fuming process from 1927 to 1982.

The ASARCO smelter has emitted particles containing heavy metals into the air during its 100 years of operation. Investigations conducted at the Site revealed substantially elevated levels of hazardous substances such as lead, cadmium, arsenic, and other elements in the soils, vegetation, livestock, surface water, and groundwater within the area around the smelter. In addition, blood lead studies conducted in the area indicate that elevated levels of lead have been found in many of the children living in East Helena.

The hazardous substances present at the Site, including arsenic, lead, cadmium, zinc, and other elements, continue to be emitted from facilities at the plant such as the smelter's stacks, sinter building, dross building, ore storage areas, and blast furnaces. In addition, American Chemet Corporation emits smaller volumes of metals into the air. Finally, metals-laden dust particles, which become reentrained by wind, water and traffic, are a continuous source of contamination at this Site and contribute to elevated metals found in household dust.

In September 1984, the U.S. Environmental Protection Agency (EPA) listed the East Helena Site on the National Priorities List (NPL) pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The East Helena Site was originally divided into the following five operable units: the process ponds and fluids; groundwater; surface water and soils; the slag pile; and the ore storage areas. More recently, the EPA consolidated the Site into three operable units: the process ponds and fluids; groundwater; and the remainder of the Site, including surface water and soils. The principal Potentially Responsible Party (PRP), ASARCO, has completed an Remedial Investigation/Feasibility Study (RI/FS) for the Process Ponds operable unit and the associated Record of Decision was completed in November 1989. The remaining operable units are addressed in the draft Comprehensive RI/FS developed by the ASARCO and its consultants in March 1990. The Comprehensive RI/FS has undergone review by EPA, MDHES, and their consultants. The review comments as they relate to residential soils, Wilson Irrigation Ditch and vegetation were submitted to ASARCO in February 1991.

2.3 SITE INVESTIGATIONS

Previous Investigations and Analyses

Three significant studies have been completed by governmental agencies and ASARCO as part of the Site Remedial Investigation/Feasibility Study process. These include:

- East Helena, Montana Child Lead Study - Summer 1983 (CDC and MDHES 1986);
- Remedial Investigation of Soils, Vegetation and Livestock for East Helena Site (ASARCO), East Helena, Montana (EPA 1987); and
- Comprehensive Remedial Investigation/Feasibility Study - Draft (ASARCO 1990).

Data relating to contaminant levels in soils, dust, ambient air, children's blood, and garden vegetables have been selected from the above listed studies and are exhibited in Tables 1 through 9.

As part of the Phase I RI, surface soil samples were collected to define the areal extent of contamination in the Helena Valley (EPA 1987). Some of these soils were within the city limits of East Helena. In 1987 additional surface soils within the city limits were collected as part of the Phase II RI. Data from these two sampling efforts were combined and presented in the Comprehensive RI/FS (ASARCO 1990). Table 1 displays some of these data for nine elements arranged by minimum, maximum and mean concentrations. Table 2 exhibits elemental levels found in surface soils from two public parks and two elementary schools within the city limits of East Helena.

During the 1983 Child Lead Study, a large number of soils samples was collected from locations around those homes where young children resided. Many of the soil sample locations corresponded with the residences of the children whose blood lead levels were tested. Table 3 shows lead concentrations in these soils samples arranged by residential area and collection areas around the homes. Highest lead soil levels were found in residential Area 1 (closest proximity to the smelter), and in general, side yards had soils with highest lead concentrations. When these data were arranged by distance from the smelter (Table 4), highest lead concentrations were found in soil samples taken within one half mile from the smelter and they decreased as distance increased. In Table 5 these same data were grouped by residential block and it was found that within a residential city block there can be considerable variation in soil lead levels.

Major factors contributing to elevated concentrations of lead in East Helena children's blood were dust lead levels, air lead levels, distance from the smelter, and household members who smoke. Table 6 exhibits lead concentrations found in dust samples collected from household vacuum cleaner bags. Table 7 displays ambient air lead data collected during the 1983 Child Lead Study. Table 8 shows children's blood lead concentration arranged by residential area (distance from the smelter).

Samples of garden vegetables were collected from gardens within the city of East Helena during the Comprehensive RI/FS (ASARCO 1990). Concentrations of arsenic, cadmium, lead, and zinc in these vegetables are shown in Table 9.

TABLE 1

TOTAL CONCENTRATIONS OF SELECTED ELEMENTS IN SURFACE SOILS COLLECTED WITHIN RESIDENTIAL AREAS OF EAST HELENA IN 1984 AND 1987[1].

Element	Number of Soil Samples	Soil Concentration (mg/kg - dry weight) Minimum	Maximum	Arithmetic Mean	Standard Deviation
Arsenic (As)	38	8.8	218	57.1	45.0
Cadmium (Cd)	42	4.2	112	24.8	25.2
Chromium (Cr)	42	9.0	39.0	19.1	7.9
Copper (Cu)	42	34.0	6200	347	964
Lead (Pb)	42	126	7225	1121	1407
Manganese (Mn)	42	321	1175	533	163
Mercury (Hg)	38	0.2	16.0	2.5	3.6
Silver (Ag)	42	0.65	24.0	4.5	5.2
Zinc (Zn)	42	108	5200	596	855

1 Data adapted from: Comprehensive Remedial Investigation/Feasibility Study. ASARCO, Incorporated, East Helena, Montana. Table 5-1-2, page 5-6 (March 30, 1990).

NOTE: Total concentrations (arithmetic mean ± std. dev. in mg/kg) in surface soils collected from background sites (N=3) during the 1984 East Helena Remedial Investigation: As (16.3±1.5); Cd (.25±.07); Cr (15.3±1.5); Cu (16.3±0.6); Pb (11.7±1.5); Mn (341±70); Hg (.08±.03); Ag (.25±.18); and Zn (47.2±7.0). These data adapted from Remedial Investigation of soils, vegetation, and livestock, U.S. Environmental Protection Agency. Tables 3-1, page 3-7 (May 1987).

TABLE 2
TOTAL CONCENTRATIONS OF SELECTED ELEMENTS IN SURFACE SOILS COLLECTED FROM SCHOOL GROUNDS AND PUBLIC PARKS OF EAST HELENA IN 1987[1].

Element	Number of Soil Samples	Soil Concentration (mg/kg-dry weight)			
		Main Street Park	Kennedy Park	Radley School	East Gate School
Arsenic	1	140	R[2]	75.0	23.0
Cadmium	1	50.0	44.0	20.0	4.2
Chromium	1	18.0	19.0	16.0	21.0
Copper	1	830	460	298	58.0
Lead	1	1993	2118	1160	152
Manganese	1	885	775	473	438
Mercury	1	2.2	R[2]	1.4	0.27
Silver	1	12.0	8.4	5.9	1.25
Zinc	1	1470	960	888	108

[1] Data adapted from: Comprehensive Remedial Investigation/Feasibility Study. ASARCO Incorporated, East Helena, Montana. Table 5-1-5, page 5-10 (March 30, 1990).

[2] R = Value rejected during validation.

TABLE 3
TOTAL CONCENTRATION OF LEAD IN SOILS COLLECTED FROM RESIDENTIAL YARDS
IN EAST HELENA DURING THE 1983 CHILD LEAD STUDY[1]

Residential Areas[2]	Number of Soil Samples	Soil Collection Area	Soil Concentration (mg/kg dry weight)		
			Minimum	Maximum	Arithmetic Mean
1	71	Front/backyard[3]	81	3414	1109
	71	Sideyard	41	7964	1465
	55	Playarea	3	5770	920
	27	Garden	70	2038	645
2	167	Front/backyard[3]	58	1252	262
	93	Sideyard	3	883	228
	117	Playarea	3	6030	280
	49	Garden	50	599	220
3	28	Front/backyard[3]	54	237	98
	28	Sideyard	47	500	120
	20	Playarea	28	373	96
	5	Garden	58	162	104

[1] Adapted from: East Helena, Montana Child Lead Study, Summer 1983. CDC, U.S. Department of Health and Human Services, Montana Department of Health and Environmental Sciences, Lewis and Clark County Health Department, EPA, Final Report-March 1986. Table 7, page 43.

[2] Area 1: Residences within one mile of smelter; Area 2: Residences between 1 mile and 2.25 miles from smelter; Area 3: Residences greater than five miles from smelter.

[3] Soils from front and backyards were composited.

TABLE 4
TOTAL CONCENTRATION OF LEAD IN SURFACE SOILS COLLECTED FROM RESIDENCES DURING THE 1983 EAST HELENA CHILD LEAD STUDY ARRANGED BY DISTANCE FROM THE SMELTER[1].

Distance (miles) From Smelter	Number of Soil Samples	Soil Lead Concentration (mg/kg-dry weight) Minimum	Maximum	Geometric Mean
0 to 0.5	112	7.7	6462	1213 a[2]
0.5 to 0.75	140	3.2	7965	421 b
0.75 to 1.0	124	3.1	1411	308 c
1.0 to 2.25	620	3.2	6031	159 d

[1] Data adapted from: Comprehensive Remedial Investigation/Feasibility Study. ASARCO, Incorporated, East Helena, Montana. Table 5-1-7, page 5-15 (March 30, 1990).

[2] Means followed by different letter are statistically distinct ($p \leq 0.10$) as determined by analysis of variance and least significant difference (LSD).

TABLE 5
TOTAL CONCENTRATION OF LEAD IN SURFACE SOILS COLLECTED FROM RESIDENCES DURING THE 1983 EAST HELENA CHILD LEAD STUDY ARRANGED BY CITY BLOCK[1]

City Block Designation[2]	Number of Soil Samples	Soil Lead Concentration (mg/kg-dry weight) Minimum	Maximum	Geometric Mean
Clark	32	402	5770	1807 a[3]
Main	32	122	7965	1871 a
Riggs	48	7.7	5076	755 b
Groschell	44	10.4	3705	573 b
Clinton	40	8.7	6537	247 c
King	28	208	2518	631 b
Dudley	20	3.1	798	256 c
Lewis	28	98	1411	339 c

[1] Data adapted from: Comprehensive Remedial Investigation/Feasibility Study. ASARCO, Incorporated, East Helena, Montana. Table 5-1-8, page 5-17 (March 30, 1990).

[2] City block is designated by name of northern bounding street and consists of one city block deep in the north-south direction by all blocks in the east-west direction within the East Helena city limits.

[3] Mean followed by different letter are statistically distinct ($p \leq 0.10$) as determined by analysis of variance and least significant difference (LSD).

TABLE 6
TOTAL CONCENTRATION OF LEAD IN DUST COLLECTED FROM HOUSEHOLD VACUUM CLEANER BAGS IN EAST HELENA DURING THE 1983 CHILD LEAD STUDY[1]

		Lead Dust Concentration (ppm)		
Residential Area[2]	**Number of Dust Samples**	**Minimum**	**Maximum**	**Arithmetic Mean**
1	54	240	18361	2186
2	99	119	2651	687
3	26	80	1351	449

[1] Data adapted from: East Helena, Montana Child Lead Study, Summer 1983. CDC, U.S. Department of Health and Human Services, Montana Department of Health and Environmental Sciences, Lewis and Clark County Health Department, EPA, Final Report-March 1986. Table 11, page 47.

[2] Area 1: Residences within one mile of smelter; Area 2: Residences between one mile to 2.25 miles of smelter; Area 3: Residences greater than five miles from smelter.

TABLE 7
TOTAL CONCENTRATIONS OF LEAD IN AMBIENT AIR SAMPLES COLLECTED IN EAST HELENA DURING THE 1983 CHILD LEAD STUDY[1]

Residential Area[2]	Sampling Site	Mean Lead Concentration ($\mu g/m^3$) during sampling period			
		July	August	September	July-September
1	Firehall	4.98 (7)[3]	4.76 (10)	4.65 (8)	4.79 (25)
	Hadfield	1.73 (3)	2.92 (11)	3.49 (10)	3.01 (24)
	Hastie	2.64 (8)	3.09 (8)	3.08 (8)	3.01 (24)
	Dartman	2.09 (6)	3.33 (10)	3.14 (9)	2.96 (25)
2	Schneider	1.80 (3)	2.06 (9)	1.99 (7)	2.00 (19)
	Dudley	0.34 (3)	0.27 (10)	0.28 (9)	0.28 (22)
	South	0.87 (6)	0.83 (11)	0.69 (10)	0.79 (27)
3	Townsend	0.07 (1)	0.25 (10)	0.18 (10)	0.21 (21)

1 Data adapted from: East Helena, Montana Child Lead Study, Summer 1983. CDC, U.S. Department of Health and Human Services, Montana Department of Health and Environmental Sciences, Lewis and Clark County Health Department, EPA, Final Report - March 1986. Table 17, page 51.

2 Area 1: Sites within one mile of smelter; Area 2: Sites between 1 mile and 2.25 miles of smelter; Area 3: Sites greater than five miles from smelter.

3 Number of samples are in parentheses.

NOTE: Ambient air criteria for lead: not to exceed 1.5 $\mu g/m^3$ (90 day average). ARM 16.8.818 Ambient Air Quality for Lead.

TABLE 8
TOTAL CONCENTRATION OF LEAD IN BLOOD COLLECTED FROM CHILDREN LIVING WITHIN THE EAST HELENA AREA IN 1983[1].

Residential Area[2]	Number of Children Evaluated	Lead Blood Concentration (µg/d(ppm)) Minimum	Maximum	Arithmetic Mean
1	98	3.0	33.0	13.0
2	237	1.0	24.0	9.4
3	61	2.0	17.0	6.6

1 Data adapted from: East Helena, Montana Child Lead Study, Summer 1983. CDC, U.S. Department of Health and Human Services, Montana Department of Health and Environmental Sciences, Lewis and Clark County Health Department, EPA, Final Report-March 1986. Table 2, page 40.

2 Area 1: Children living within one mile of smelter; Area 2: Children living within one mile to 2.25 miles of smelter; Area 3: Children living more than five miles from smelter.

TABLE 9
TOTAL CONCENTRATION OF SELECTED ELEMENTS IN VEGETABLES
COLLECTED FROM GARDENS WITHIN EAST HELENA DURING 1987[1]

Vegetable	Number of Samples	Statistic	Concentration (mg/kg-dry weight)			
			Arsenic (As)	Cadmium (Cd)	Lead (Pb)	Zinc (Zn)
Carrot	10	Minimum	0.04	0.05	0.05	1.2
		Maximum	0.20	0.60	1.2	6.5
		Mean	0.10	0.20	0.33	2.9
Lettuce	9	Minimum	0.08	0.20	0.29	1.79
		Maximum	0.65	1.82	12.3	19.3
		Mean	0.34	0.64	2.91	6.2
Potato	10	Minimum	0.07	0.10	0.04	3.1
		Maximum	0.50	0.44	1.74	23
		Mean	0.16	0.19	0.54	7
Tomato	10	Minimum	0.004	0.02	0.002	0.85
		Maximum	0.03	0.10	0.23	1.98
		Mean	0.01	0.05	0.06	1.30
Beet Greens	8	Minimum	0.03	0.20	0.01	3.8
		Maximum	0.47	2.8	4.7	52.8
		Mean	0.20	1.25	1.41	21.6
Swiss Chard	2	Minimum	0.05	0.14	0.31	3.8
		Maximum	0.84	2.1	0.77	19.2
Parsley	1	Value	0.12	0.24	1.5	10.5

1 Data adapted from: Comprehensive Remedial Investigation/Feasibility Study. ASARCO Incorporated, East Helena, Montana. Table 5-3-2, page 5-102 (March 30, 1990).

NOTE: Total concentrations (mg/kg) found in vegetables collected from background garden (Townsend, MT) were: carrot [As (.02); Cd (.04); Pb (.003): Zn (.96)]; lettuce [As (.006); Cd (no data); Pb (.01); Zn (1.27)]; potato [As (.08); Cd (.17); Pb (.18); Zn (6.5)]; tomato [As (.02); Cd (no data); Pb (no data); Zn (2.4)]; beet greens [As (.04); Cd (.06); Pb (.18); Zn (5.2)]; swiss chard [no data]; parsley [no data]. These data adapted from: Comprehensive Remedial Investigation/Feasibility Study. ASARCO Incorporated, East Helena, Montana. Table 5-3-1, page 5-101 (March 30, 1990).

2.4 SITE CONDITIONS THAT JUSTIFY A REMOVAL ACTION

This section describes conditions at the Site that justify a removal action based on consideration of the factors set forth in 40 CFR section 300.415(b)(2).

The EPA proposed to add the East Helena smelter site to the National Priorities List (NPL) of uncontrolled hazardous waste sites in September 1983. In September 1984, the East Helena smelter site was officially listed on the NPL.

A 1975 study of approximately 90 East Helena children, which was conducted by the National Centers for Disease Control (CDC), revealed four children with lead/blood ratios in excess of 40 micrograms/deciliter (40 μg/dL) and twenty other children with lead/blood ratios in excess of 30 μg/dl. The CDC had previously established that children exhibiting a lead/blood ratio in excess of 30 μg/dl should be treated for lead poisoning. In 1983, a similar study of approximately 400 East Helena children (aged 1-5 years) was conducted by the CDC. Ninety eight subjects lived within one mile of the smelter and 66 of them were within or above the CDC's current range of concern for lead poisoning (10-15 μg/dL).

Recent medical research, as reported by the U.S. Department of Health and Human Services in a report to Congress (July 1988), indicates that blood lead levels thought to be safe five years ago are not safe. Children under six are especially susceptible to lead's toxic effects and these effects manifest themselves over very short periods in developing children. Even in adults, particularly women who plan to bear children, effects of lead are being uncovered at lower and lower doses. Although medical experts agree the level of concern is now 10-15 μg/dL lead, there is probably no safe level of lead for children.

According to the July 1988 report to Congress and other sources, lead exposure can cause a decrease in the concentration of blood proteins, such as hemoglobin, which transports oxygen throughout the body, and can impair the utilization of iron. Such exposure can also produce neurobiological defects, such as learning disabilities and behavioral problems in children.

Preliminary remedial investigations conducted from 1984 through 1987 by EPA, which were designed to determine fully the nature and extent of the public health, or welfare or environmental effects of any release of hazardous substances, pollutants and contaminants from the East Helena smelter Site, resulted in the following findings:

1. The elements silver, arsenic, cadmium, copper, mercury, manganese, lead, selenium, thallium and zinc are significantly enriched compared to background levels in the valley's soils;

2. The elements arsenic, cadmium, copper, mercury, lead, and in some cases zinc, are enriched compared to background levels in the principal crops grown in the valley;

3. The element lead was significantly elevated in the blood of all eight cattle herds tested in the valley and the elements arsenic, cadmium, and zinc were significantly elevated in, respectively, six, two, and four of the eight herds tested, as compared to a control herd; and

4. The maximum concentrations of those elements enriched in the three media investigated are found immediately adjacent to the East Helena smelter Site.

Data relating to contaminant levels of these elements in soils, dust, ambient air, children's blood, and garden vegetables have been selected from these data bases and are exhibited in Tables 1 through 9. These data support the decision to take action on residential soils that are contaminated with metals (cadmium, copper, lead, manganese, mercury, silver, zinc, and others) and arsenic.

A September 1989 directive issued by the EPA's Office of Solid Waste and Emergency Response (OWSER Directive No. 9355) set an interim residential soil cleanup level for lead at 500-1,000 parts per million. This directive was issued to provide guidance until a national policy can be developed to verify a cancer potency factor or reference dose for lead.

The directive adopts a recommendation made by the National Centers for Disease Control (CDC), concerning childhood lead poisoning, and it is to be followed when the land use is residential.

Arsenic exposure has been linked to increased incidence of human lung and skin cancer. Cadmium has been demonstrated to cause cancer in animals, and is a suspected human carcinogen. Cadmium may also be a human mutagen or teratogen and thus may affect the kidneys, bones, liver, reproductive system, respiratory tract or immune system. Cadmium inhibits the body's ability to absorb essential elements, such as copper and calcium, and may lead to deficiencies of those elements.

Arsenic, cadmium, copper, mercury, manganese, lead, selenium, silver, thallium and zinc are defined as hazardous substances by section 101(14)(D) of CERCLA.

EPA has determined that hazardous substances, as described above, have been and continue to be released into the air, soil, surface water, and groundwater at the Site and surrounding area as a result of the operation of the East Helena smelter. Contaminated soils are directly or indirectly ingested and are also reentrained into the air as inhalable particles. It has also been determined that the soils in the area are the source of the elevated lead levels in children, livestock, and vegetation in East Helena. By removing the contaminated soils in the residential areas of East Helena, particularly those with the highest concentrations of metals and arsenic, the human health risks will be greatly reduced.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

The removal action objectives define the "why," "what," and "when" of a removal action. The objectives also delineate the limits of acceptable technical performance and institutional factors. Removal-action objectives as defined by EPA guidance are provided in the following paragraphs.

3.1 STATUTORY LIMITS ON REMOVAL ACTIONS

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 104(c)(1), as amended by the Superfund Amendments and Reauthorization Act (SARA), provides that "Fund-financed removal actions other than those authorized by Section 104(b), as amended, shall not continue after $2 million has been obligated for the action or 12 months have passed from the date of initial response unless the lead agency (EPA) grants an exemption in accordance with the criteria set forth in Section 104(c)(1), as amended." The East Helena residential soils removal action is not a Fund-financed action; therefore, it is not restricted to the 12 month/$2 million statutory limit criteria.

3.2 REMOVAL ACTION SCOPE AND SCHEDULE

The scope of this EE/CA equivalent is to address ways to abate the threat to human health, welfare, and the environment, posed by contaminated residential soils. This EE/CA equivalent includes an evaluation of management and disposal options for these soils.

More specifically, the scope of this EE/CA equivalent is to eliminate the significant threats to human health, welfare and the environment posed by surface soils in yards, playgrounds, gardens, parks, unpaved streets and alleys, and portions of the Wilson irrigation ditch contaminated with more than 1,000 parts per million (ppm) lead, and elevated levels of arsenic, cadmium, copper, zinc, and other hazardous substances. EPA estimates that this action will impact approximately 250-350 yards, lots, playgrounds and other areas.

Eventually, many more areas may require remediation due to elevated levels of lead. However, those areas with soil contamination below 1,000 ppm lead will not be addressed in this removal action. A remedial investigation and feasibility study (RI/FS), which will identify and address cleanup alternatives for less contaminated soils, is being finalized, and decisions concerning final cleanup alternatives and final soil action levels are expected to be made in 1992 or 1993 prior to the expected completion of the removal action. Consequently, EPA anticipates that action contemplated in the RI/FS will follow directly after this removal action.

As provided in Section 104(b) of CERCLA, 42 U.S.C. § 9604, the actions evaluated in this EE/CA equivalent will contribute to the efficient performance of any long-term remediation with respect to the Site. An additional objective is to comply, to the extent practicable, with the applicable or relevant and appropriate requirements (ARARs) for the Site.

In order to satisfy administrative requirements related to air monitoring at the Site, construction will not begin before July 1, 1991. The construction season will be limited by winter weather. Due to the July start date, the first season will consist of approximately 4 months of actual work. The following season is likely to be 6-8 months long. Barring unforeseen circumstances, EPA anticipates that the removal will be completed in two to three field seasons. As stated above, EPA expects to assure that remediation will immediately follow the removal action, in order to continue with additional soil clean-up activities.

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

3.3.1 Framework for Identifying ARARs

This section identifies potential ARARs for the residential soils removal action. EPA's policy is that removal actions attain, to the extent practicable considering the exigencies of the situation, ARARs under federal environmental or more stringent state environmental or facility siting laws (Final National Contingency Plan [NCP], 40 C.F.R. § 300.415(i); Preamble to Final NCP, 55 Fed. Reg. 8695 [March 8, 1990]).

Applicable requirements are defined as those cleanup standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant response action, or location at a CERCLA Site. Relevant and appropriate requirements are those cleanup standards, standards of control and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, response action, location, or other circumstance at a CERCLA Site, address problems or situations sufficiently similar to those encountered at the CERCLA Site that their use is well suited to the particular Site (Final NCP, 40 C.F.R. § 300.5).

As the definitions of "applicable" and "relevant and appropriate" specify, only substantive requirements may be identified as ARARs. Substantive requirements are those requirements that pertain directly to actions or conditions in the environment. They are requirements that in and of themselves define a level or standard of control (Preamble to Final NCP, 55 Fed. Reg. 8756-57; EPA Compliance With Other Laws Manual, pp. 1-11, OSWER Directive 9234.01 [August 1988]). Administrative requirements are those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation. Administrative requirements include the approval of or consultation with administrative bodies, issuance of permits, documentation, reporting, recordkeeping, and enforcement. Requirements that do not in and of themselves define a level or standard of control are considered administrative requirements, and are not identified as ARARs (Preamble to Final NCP, 55 Fed. Reg. 8756-57; Compliance With Other Laws Manual, pp. 1-11).

Requirements are ARARs only when they pertain to the specific action being conducted (Preamble to Final NCP, 55 Fed. Reg. 8695). The residential soils removal action is limited in scope to replacement of the highly contaminated residential soils north of the East Helena Smelter and associated elements such as management of the excavated soils. Requirements that do not pertain to this specific removal action have not been identified as ARARs.

3.3.2 Identification of ARARs

A list and description of ARARs for the residential soils removal action is set forth below. This list was compiled based on the framework described in Section 3.3.1 above and evaluation of specific removal alternatives that may be applicable to this removal action.

I. CHEMICAL SPECIFIC ARARs

a. Lead

COMMENT: No person shall cause or contribute to concentrations of lead in the ambient air which exceed 1.5 micrograms per cubic meter (mg/cm) of air, measured over a 90-day average.

CITATION: Promulgated at ARM § 16.8.818 as part of a federally approved State Implementation Plan (SIP), pursuant to the Clean Air Act of Montana, MCA 75-2-101 et seq. Corresponding federal regulations are found at 40 C.F.R. § 50.12, promulgated pursuant to section 109 of the Clean Air Act, 42 U.S.C. § 7409.

CLASSIFICATION: Applicable.

b. Particulate Matter

COMMENT: No person shall cause or contribute to concentrations of PM-10 (particulate matter that is 10 microns in diameter or smaller) in the ambient air which exceed:

- 150 micrograms per cubic meter of air, 24 hour average, no more than one expected exceedance per calendar year;

- 50 micrograms per cubic meter of air, annual average.

CITATION: Promulgated at ARM § 16.8.821 as part of a federally approved SIP, pursuant to the Clean Air Act of Montana, MCA 75-2-101 et seq. Corresponding federal regulations are found at 40 C.F.R. § 50.6, promulgated pursuant to section 109 of the Clean Air Act, 42 U.S.C. § 7409.

CLASSIFICATION: Applicable.

COMMENT: Construction must not be undertaken unless reasonable precautions are taken to control emissions of airborne particulate matter.

CITATION: Promulgated at ARM 16.8.1401(4), pursuant to the Clean Air Act of Montana, MCA 75-2-101 et seq. These regulations were promulgated pursuant to an approved SIP pursuant to section 110 of the Clean Air Act, 42 U.S.C § 7410.

CLASSIFICATION: Applicable.

c. Occupational Health and Safety Standards

COMMENT: No worker shall be exposed to concentrations greater than:

*Arsenic	0.5 micrograms per cubic meter (mg/m3)
Inorganic Arsenic	10.0 mg/m3
Copper	1.0 mg/m3
*Lead	0.15 mg/m3
Manganese	5.0 mg/m3
Selenium compounds	0.2 mg/m3
Silver	0.01 mg/ml
Cadmium dust	0.2 mg/m3, 8 hour average
Mercury	0.1 mg/m3 acceptable ceiling
Inert/nuisance dust	5 mg/m3
Total dust	15 mg/m3

CITATION: Promulgated at 29 C.F.R. §§ 1910.1000, 1910.1018(c), and 1910.1025(c), pursuant to the Occupational Safety and Health Act, 29 U.S.C. §§ 651-678, except for those standards marked with a *, which are promulgated at ARM § 16.42.102, pursuant to the Occupational Health Act of Montana, MCA § 50-70-113.

CLASSIFICATION: Applicable.

d. Generators of air pollution must achieve and maintain such levels of air quality as will protect human health and safety, to the greatest extent practicable.

CITATION: MCA § 75-2-102, pursuant to the Clean Air Act of Montana.

CLASSIFICATION: Applicable.

II. LOCATION SPECIFIC ARARs

a. Significant Data

COMMENT: If significant scientific, prehistorical, historic, or archaeological data are found, they must be preserved in an appropriate manner. To date, no such data have been found at the Site. However, if such data are discovered, this ARAR applies.

CITATION: Promulgated at 40 C.F.R. § 6.301(c), pursuant to the Archaeological and Historic Preservation Act, 16 U.S.C. § 469.

CLASSIFICATION: Applicable if activity may cause irreparable loss or destruction of significant data.

b. Significant structures

COMMENT: If any district, Site, building, structure or object which is included in or eligible for the National Register of Historic Places, is located in the area affected by the removal action, consultation with the State Historic Preservation Officer is required, and efforts should be undertaken to avoid impacts on these area. To date, no such areas have been found at the Site.

CITATION: Promulgated at 40 C.F.R. Section 6.301(b) and 36 C.F.R. Part 800, pursuant to the National Historic Preservation Act, 16 U.S.C. § 470 et seq.

CLASSIFICATION: Applicable if activity affects any property listed or eligible for listing on National Register of Historic Places.

III. ACTION SPECIFIC ARARs

a. General ARARs

COMMENT: During construction at the Site, standards governing the protection of occupational health and safety must be complied with. These include the establishment of health and safety programs and practices for on-site workers, and the provision of protective equipment, should conditions warrant. Full requirements are contained in the cited provisions.

CITATION: 29 C.F.R. Part 1926, 20 C.F.R. §§ 1910.120, and 1910.132, promulgated pursuant to the Occupational Health and Safety Act, 29 U.S.C. §§ 651-678.

CLASSIFICATION: Applicable.

COMMENT: Every employer must provide a safe place of employment, shall furnish and use and require the use of such safety devices and safeguards and shall adopt and use such practices, means, and processes as are reasonably adequate to render the place of employment safe and shall do every other thing reasonably necessary to protect the life and safety of employees.

CITATION: MCA § 50-71-201, of the Montana Safety Act.

CLASSIFICATION: Applicable.

b. Storage of Excavated Soils

As part of the removal action, testing will be conducted to determine whether the soils exhibit characteristics of hazardous waste or solid waste. If test results indicate that the soils are characteristic hazardous waste, Subtitle C of the Resource Conservation and Recovery Act, as amended, 42 U.S.C. § 6901 et seq. ("RCRA") will be applicable. If test results indicate that the soils are not characteristic hazardous waste, Subtitle D of RCRA, which regulates the treatment, storage, and disposal of solid wastes, will be applicable.

RCRA Subtitle C Requirements:

40 CFR Part 262 - Standards Applicable to Generators of Hazardous Waste.

40 CFR Part 264 - Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.

Subpart L - Storage and treatment of hazardous waste in piles.

Subpart M - Treatment or disposal of hazardous waste in land treatment units.

Subpart N - Disposal of hazardous waste in landfills.

Montana Hazardous Waste Management Act - MCA § 75-10-401 et seq.

RCRA Subtitle D Requirements:

40 CFR Part 257 - Criteria for Classification of Solid Waste Disposal Facilities and Practices.

Montana Solid Waste Management Act - MCA § 75-10-201 et seq. - Portions related to disposal and transportation of solid waste.

4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

Remedial action alternatives were developed in the draft Remedial Investigation/Feasibility Study for Residential Soils, Wilson Ditch Sediments and Vegetation report, prepared by ASARCO (Draft RI/FS Report) (attached). The draft RI/FS Report, developed remedial action alternatives which included the full range of possible removal action alternatives for the contaminated residential soils in East Helena (see, in particular, Section 11 of the Draft RI/FS report).

4.1 BASIS FOR ALTERNATIVE SCREENING

The alternative screening in this EE/CA Equivalent complies with the March 30, 1988 EPA "Outline of EE/CA Guidance". The current emphasis for alternative screening is based on effectiveness, implementability, and, to a lesser extent, cost. Attaining public health and environmental objectives is considered to be a component of effectiveness screening and is also considered part of the subsequent detailed analysis of alternatives. A discussion of each of the three criteria used in the screening process follows.

4.1.1 Effectiveness

The evaluation of effectiveness included the protectiveness of human health and the environment, and the reduction of contaminant toxicity, mobility, or volume.

4.1.2 Implementability

The major factors in the implementability evaluation included technical feasibility, administrative feasibility, and availability.

4.1.3 Cost

This screening also included initial cost estimates of each alternative. Cost estimates were based on available information including generic unit costs, commercial information, cost estimating guides and engineering judgement. Major factors in the cost evaluation included capital costs, annual operation and maintenance costs, and present worth analyses. A discount factor of 5% over a 30-year time frame was used for present worth analyses.

4.2 PRELIMINARY SCREENING

All management options listed in Section 11 of the attached Draft RI/FS Report were screened with respect to the previously discussed criteria. Results of this initial screening are summarized in that section. The process options that passed the initial screening are also presented in Section 11.

4.3 DEVELOPMENT OF ALTERNATIVES FOR DETAILED ANALYSIS

Process options that passed the initial screening were assembled into alternatives to form a range of appropriate response actions. Section 5.0 of this EE/CA presents a detailed analysis of the remaining alternatives.

5.0 DETAILED ANALYSIS OF REMAINING REMOVAL ACTION ALTERNATIVES

The alternatives that passed the initial screening underwent a more detailed analysis to permit the agency to select the preferred response action. This detailed analysis was performed in Table 11-6-2 of the attached Draft RI/FS Report. The basis for the detailed analysis and the analysis of the alternatives is provided in the following paragraphs.

5.1 BASIS FOR DETAILED ANALYSIS

In accordance with the March 30, 1988, EPA "Outline of EE/CA Guidance," section 11.4 of the attached Draft RI/FS Report discusses the criteria for detailed analysis, and presents the actual analyses of each removal action alternative.

5.1.1 Effectiveness

This criterion focuses on the degree to which an alternative protects human health and the environment, complies with ARARs, minimizes residual risks and affords long-term protection, and minimizes short-term effects.

5.1.2 Implementability

This criterion focuses on the technical feasibility and availability of the technologies each alternative uses and the administrative feasibility of implementing the alternative. Construction and operation, technological reliability, and the ability to implement additional remedial actions, if necessary, are factors in evaluation of technical feasibility. Administrative feasibility considers agency coordination and requirements such as permits or right-of-way considerations. The implementability criterion also addresses the availability of services and materials for each alternative.

5.1.3 Cost

Estimates of capital costs, and operation and maintenance costs are presented in Table 11-6-2. A present worth analysis for each alternative is included in this table. This analysis allows capital and annual costs to be compared on a consistent basis. A discount factor of 5 percent and a planning period of 30 years were used for long term evaluation. Planning periods were adjusted for alternatives that were completed over shorter periods of time.

Detailed cost estimate calculations are also shown in Table 11-6-2 of the Draft RI/FS Report. This table presents volumes or areas of media used for calculations, unit prices, useful life of alternatives, and assumptions used for detailed cost estimates. Direct capital costs (construction, land development, buildings and services, etc.), indirect capital costs (engineering cost, license or permit costs, contingency allowances, etc.) replacement costs, annual operation and maintenance costs (operating labor cost, maintenance material and labor costs, operating materials and energy, residues, purchased services, administrative costs, insurance, taxes and licensing costs) are all considerations in the alternative cost estimates.

6.0 COMPARATIVE ANALYSIS

The Draft RI/FS Report presented a detailed analysis of each of the alternatives listed below:

SW-4	No Action
SW-5A	Limited Action-Institutional Restrictions
SW-6A	Containment by Capping and Lawn Care
SW-6B	Excavate Residential Soils and Pave Alleys and Driveways
SW-6C	Landfarming Excavated Soils in Fields East of the Smelter
SW-6F	Disposal of Excavated Soils in a RCRA Designed Facility Constructed within the East Fields Area
SW-6G	Stockpile of Excavated Soils in East Field Area
SW-7A	Smelting of Excavated Soils
SW-7B	Treatment of East Helena Soils by Deep Tilling
SW-7F	Treatment of Residential Soils by Chemical Fixation

Detailed comparative analyses of the alternatives were conducted in accordance with EPA guidance. The relative performance of each alternative was evaluated considering the evaluation criteria used in the detailed analysis. For the residential surface soil alternatives, the options that involve soil treatment or removal (SW-6B,SW-6C, SW-6F, SW-7A, SW-7B, and SW-7F) are more protective than alternatives that involve institutional restrictions which require voluntary cooperation of residents to be protective. Also, these options would be more permanent and effective than those that require institutional controls. Alternatives SW-5A and SW-6A implemented together would reduce the potential of exposure to metals in surface soils; however, elevated metals in surface soils would remain. Alternative SW-6G is a temporary disposal alternative that would allow a soil removal option to be expedited, while deferring a permanent disposal option until a later date.

A combination of disposal treatment or removal options would result in reduced concentrations of residential surface soils. All of the residential alternatives are technically feasible. Field tests were conducted to address Alternatives SW-6C and SW-7B and reduction and stabilization of metals in surface soils appears feasible. There could be some difficulty implementing deep tilling in confined spaces in residential areas with underground pipelines and cables. Chemical fixation (SW-7F) has been successfully implemented at other sites to immobilize metals in soils and appears feasible for East Helena residential soils. Smelting (SW-7A) has been implemented routinely for treatment of metals in soils. A disposal facility meeting RCRA secondary requirements (SW-6F) would also be technically feasible to implement. Of all the post-excavation alternatives, SW-6G (temporarily stockpile) is certainly technically feasible and may be the most appropriate alternative for handling the contaminated soils until more information can be gathered concerning the soils' characteristics.

Some institutional requirements that are components of Alternative SW-5A (public education) have been implemented.

Capital, operation and maintenance, and present worth costs for residential soil alternatives are:

Alternative	Capital Costs	O and M Costs	Present Worth
SW-4 (No Action)	$0	$0	$0
SW-5A (Institutional actions including public education and area use restrictions	$23,000	$20,000	$330,500
SW-6A (Containment by capping and lawn care)	$1,925,243	$75,000	$3,078,177
SW-6B (Excavate and pave or gravel alleys and driveways)	$5,706,038	$55,000	$5,808,306
SW-6C (Landfarm in East Fields)	$903,094	$60,000	$1,014,659
SW-6F (Dispose of Soils in RCRA Facility in East Fields)	$3,935,919	$62,800	$4,901,309
SW-6G (Stockpile excavated soils in East Fields)	$714,936	$26,750	$787,783
SW-7A (Smelt Excavated Soils)	$11,072,445	$0	$11,072,445
SW-7B (Deep tilling and revegetation)	$5,026,931	$55,000	$5,872,416
SW-7F (Chemical Fixation)	$8,719,718	$0	$8,719,718

6.1 WILSON DITCH

The Draft RI/FS Report also presented a detailed analysis of the alternatives for remediation of the Wilson Irrigation Ditch. The alternatives are listed below:

SW-14 No Action

SW-15A Institutional Restrictions

SW-15B Fence Wilson Ditch to Prohibit Access

SW-16B Replace Portions of Wilson ditch with a Buried Pipeline

SW-16C Source Containment by Disposal in Landfarm

SW-16D Landfarming Excavated Wilson Ditch Sediments in Fields East of the Smelter

SW-16G Disposal of Excavated Ditch Sediments in an RCRA Designated Facility Constructed within the East Fields Area

SW-16H Stockpile of Excavated ditch Sediments in East Fields Area

SW-17A Smelting Topsoil from Wilson Ditch

SW-17C Treat Excavated Sediments by Chemical Fixation

The comparative analysis and costs are presented in Section 11 (Tables 11-6-1 and 11-6-2) of the Draft RI/FS Report. Of the ten Wilson Ditch alternatives, SW-15B (fencing), SW-16B (replacement of ditch), and alternatives that include excavation (SW-16C, SW-16D, SW-16G, SW-16H) are most protective. With the exception of no action (SW-14) and institutional restrictions (SW-15A), all alternatives would be effective in the long-term. All of the alternatives are technically feasible. Of the disposal options, SW-16H is the easiest to implement; SW-16G is the most difficult since considerable construction is involved. Of the soil disposal alternatives, approval of stockpiling of sediments (SW-16H) is the most administratively feasible, and would allow expedited removal of ditch sediments. The relative availability of services and materials is essentially equal for all alternatives with the exceptions of SW-17A and SW-17C. Smelting services would be delayed by a backlog of material from other operable units requiring treatment. Chemical fixation services are not locally available. The estimated costs range from $59,224 (Alternative SW-16H) to $957,805 (Alternative SW-16G).

7.0 PROPOSED REMOVAL ACTION

This section presents the preferred alternative for the residential soils removal action in East Helena, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 USC Sections 9601-9675, and the National Contingency Plan (NCP), 40 CFR, Part 300.

The results of the comparative analysis of removal action alternatives indicate that excavation of contaminated residential soils, and paving of alleys and driveways (Alternative SW-6B), excavation of contaminated Wilson Irrigation Ditch sediments and soils (Alternative SW-16H, modified to include all contaminated ditch sediments and soils within residential areas), and stockpiling of all excavated soils on ASARCO's east fields (Alternative SW-6G) should be implemented. By excavating and removing contaminated soils and sediments containing more than 1,000 ppm lead from residential areas, this combination of alternatives will ensure protectiveness of human health, welfare, and the environment. By allowing the excavated materials to be stockpiled on ASARCO's east fields until the volume and toxicity of the total materials can be accurately quantified, removal activities can proceed without delay, and an appropriate amount of time can be devoted to determining the most feasible and effective disposal method for the soils.

7.1 GENERAL PARAMETERS

The soil removal action will include residential yards, school grounds, day-care centers, vacant lots, gardens, playgrounds, parks, unpaved streets and alleys and those portions of Wilson Irrigation Ditch within residential areas with concentrations of lead in excess of 1000 mg/kg lead. Based on the results of previous soil testing, removal of all soils located in the area bound by Riggs Street, Highway 12, Washington Avenue and 1st Street is necessary.

Prioritization

A proposed prioritization schedule for the removal activities is presented below:

1. Yards with households having small children or expectant mothers

2. Playgrounds, school yards and day-care centers

3. Other residential yards and gardens

4. Public areas such as parks

5. Unpaved streets and alleys

Removal Logistics

To ensure that the removal action will minimize, to the extent practicable, impacts on the residents of East Helena, additional information and input will be collected via a questionnaire developed in cooperation with the Citizens Advisory Committee. The questionnaire will include a variety of questions relating to yard and land use, property dimensions, ages and numbers of occupants at each property, property ownership, and rental or lease information.

Actions needed to mitigate short term impacts such as fugitive dust control, spillage control, traffic control of heavy equipment and trucks, noise reduction, and times for removal will be addressed in the work plan.

Temporary Storage of Excavated Soils

The soils shall be stored on the fields located east of the ASARCO Smelter Site pending a decision on their final disposition. A focused feasibility study shall be conducted as part of the removal action to determine the appropriate disposal method and location of excavated soils. As indicated in section 3.3 of this document, the soils will be tested to determine whether they should be managed as hazardous or solid waste. Final disposition of the soils will comply with applicable federal and state requirements.